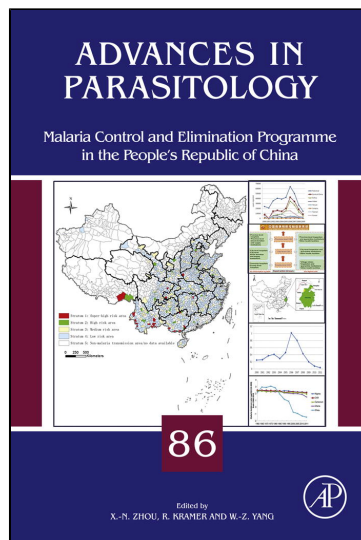


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Transition from Control to Elimination: Impact of the 10-Year Global Fund Project on Malaria Control and Elimination in China

Ru-Bo Wang^{1,2,3,*}, Qing-Feng Zhang^{1,2,3}, Bin Zheng^{1,2,3},
Zhi-Gui Xia^{1,2,3}, Shui-Sen Zhou^{1,2,3}, Lin-Hua Tang^{1,2,3}, Qi Gao⁴,
Li-Ying Wang⁵, Rong-Rong Wang⁵

¹National Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention, Shanghai, People's Republic of China

²WHO Collaborating Centre for Malaria, Schistosomiasis and Filariasis, Shanghai, People's Republic of China

³Key Laboratory of Parasite and Vector Biology, Ministry of Health, Shanghai, People's Republic of China

⁴Jiangsu Provincial Institute of Parasitic Diseases, Wuxi, People's Republic of China

⁵National Health and Family Planning Commission of the People's Republic of China, Beijing, People's Republic of China

*Corresponding author: E-mail: rubo_wang@163.com

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Abstract

The Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) supported a project on the control and elimination of malaria in People's Republic of China which was one of the biggest-scale international cooperation programmes to control malaria in the country during the past 10 years. The project promoted the effective implementation of the Chinese national malaria control programme. On the basis of epidemiologic data, an overview of the project activities and key performance indicators, the overall impact of the GFATM project was evaluated. We also reviewed relevant programme features including technological and management approaches, with a focus on best practice, innovations in implementation and the introduction of international standards. Last, we summarised the multi-stakeholder cooperation mechanism and comments on its sustainability in the post-GFATM period. Recommendations for the future management of the Chinese national malaria elimination programme are put forward after considering the challenges, shortcomings and lessons learnt during the implementation of the GFATM project in China to sustain past achievements and foster the attainment of the ultimate goal of malaria elimination for the country.



1. INTRODUCTION

The Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM) was established in Geneva in 2002 with an aim to bundle and mobilise resources for the fight against the three diseases. The approach it adopted

as the most effective way to fight these infections is to spur partnerships among government, civil society, the private sector and communities living with the diseases (Global Fund, 2002).

Since 2002, the People's Republic of China (China) successfully applied for GFATM support for 15 specific and three consolidated programmes. These included five grants dedicated to malaria, such as: Round 1 (R1), Round 5 (R5), Round 6 (R6), Round 10 (R10) and the National Strategy Application (NSA). The last grant reflected the shift from a rounds-based mode to an ever closer alignment with the National Malaria Elimination Programme (NMEP). Projects were implemented by the Centres for Disease Control and Prevention (CDCs) at different administrative levels, together with partners such as international non-governmental organizations (NGOs) and other government sectors (China PR, 2013).

Here, we critically review the activities, experiences and impacts of the GFATM-supported malaria control and elimination programme in China. We mainly rely on data obtained from the annual programme reports prepared from 2003 to 2012 and made available by the National Programme Office (NPO) and the information publicly available through the GFATM website.



2. EPIDEMIOLOGICAL JUSTIFICATION FOR ROUNDS OF GFATM MALARIA PROGRAMMES

In 2002, Yunnan and Hainan provinces still faced a serious malaria problem (Sheng et al., 2003). The number of malaria cases originating from the two provinces accounted for more than 70% of the total number in China. Migration was increasing significantly in these areas, which could result in a significant increase of malaria transmission, especially of multi-drug-resistant *Plasmodium falciparum* present on the border region of Yunnan province and in the mountainous areas of Hainan province. To control malaria in these two target provinces and limit the spread of multi-drug-resistant strains, China GFATM malaria programme R1 was implemented from 2003 to 2008.

In 2003, about 96% of the malaria cases registered in China were from six provinces: Yunnan and Hainan (both of which had falciparum malaria) and the central provinces of Anhui, Hubei, Henan and Jiangsu, where vivax malaria became an increasing problem (Liu, 2014; Zhou et al., 2005). To roll back the re-emergence of malaria in central provinces and reduce the burden of malaria across the country, the China GFATM malaria programme R5 was approved by the GFATM in 2005.

From 2001 to 2005, about 25.6% of all malaria cases registered in Yunnan province were originally from Myanmar. The surveillance and reporting systems for malaria were relatively weak in the four special administrative regions of Myanmar bordering China, and the high cross-border mobility of Chinese workers resulted in a high and difficult to manage malaria burden. In 2006, the GFATM approved the China GFATM malaria programme R6 to reduce malaria burden on the China–Myanmar border.

In 2008, the nationwide malaria situation on China met the criteria of pre-elimination recommended by the World Health Organization (WHO). Most of the remaining endemic areas were poverty-stricken counties lacking the required resources to achieve the malaria elimination goal (Bi & Tong, 2014). To achieve the stated goal of malaria elimination in China, the NSA was approved by the GFATM in 2009. Unlike the previous programmes that followed the logic of ‘rounds’, the NSA was in line with the NMEP. NSA focuses on malaria elimination of Type 1 and 2 counties whereas the government fund focuses on Type 3 and 4 counties (Type 1 – local infections detected in 3 consecutive years and the annual incidence was ≥ 1 per 10,000; Type 2 – local infections detected in the last 3 years and at least in 1 year the annual incidence was < 1 per 10,000 and > 0 ; Type 3 – no local infections reported in the last 3 years; Type 4 – non-malaria epidemic area).

Last, in 2012, the China GFATM malaria programme R10 was approved to consolidate malaria control on the China–Myanmar border with an aim to continually reduce the malaria burden in the project area and contribute to achieving malaria elimination in China by 2020.



3. GENERAL INFORMATION ABOUT ROUNDS

From 2003 to 2012, China completed R1, R5, R6 and NSA. R10 was closed by the end of 2013. Overall, approximately 116 million USD had been disbursed by the GFATM for these grants, accounting for 15.9% of the total value of all GFATM grants in China approved between 2003 and 2012 (see Table 11.1 and Figure 11.1).

In general, a GFATM grant can last for 5 years, divided into two periods – Phase I (2 years) and Phase II (3 years). The 25th GFATM board meeting in 2011 decided that the following eligibility criteria for renewal

applications would become effective started in 2012: (1) *group of 20 (G20) upper middle income countries will less than an extreme disease burden will no longer be eligible for renewals of grants*; and (2) *the counterpart financing and focus of proposal requirements under the policy on eligibility, counterpart financing and prioritization will apply*. China is a G20 member country, and the malaria burden in China is less than an extreme situation. According to the decision, NSA and R10 were closed in advance after the programme activities of Phase I finished, and the GFATM will not support malaria control and elimination in China after 2014.

The coverage of Global Fund-supported projects gradually expanded from 47 counties in 2003 to 762 counties in 20 provinces in 2010 ([Figure 11.2](#)). Most of the project areas were poverty-stricken regions with relatively weak economic conditions and a heavy malaria burden.

3.1 GFATM malaria programme in China: R1

GFATM malaria programme R1 covered 25 border counties of the Yunnan province, 10 counties of the Hainan province and 12 counties of the other eight project provinces or autonomous regions (including Henan, Hubei, Anhui, Jiangsu, Guangdong, Guangxi, Sichuan and Guizhou). The main activities included early diagnosis, appropriate treatment and effective protection; malaria management among mobile populations in border areas of Yunnan; malaria-related health education and promotion; malaria surveillance and programme management capability.

3.2 GFATM malaria programme in China: R5

The target area for R5 covered 6 provinces, namely Yunnan, Hainan, Anhui, Henan, Hubei and Jiangsu provinces. Overall, 19.14 million people at risk living in rural areas of 1813 townships in 121 counties benefited directly and a further 63.8 million benefited indirectly from the activities. The activities were integrated into the NSA in 2010. The project pursued three strategic objectives: (1) prevention, (2) diagnosis and treatment and (3) surveillance and epidemic response. Malaria control and management capacity in target areas were enhanced through the introduction of new techniques, including artemisinin-based combination therapy (ACT), rapid diagnosis tests (RDTs), long-lasting insecticide-treated nets (LLINs) and multi-sectorial participation as well as health education.

Table 11.1 Key information about the GFATM malaria programmes in China

Round	Period	Approved budget (USD)	Coverage	Beneficiaries	Overall goal
R1	2003–2008	6,347,448	47 counties in 10 provinces of China	9.3 million	Roll back malaria in target provinces and control the spread of multi-drug-resistant malaria
R5	2006– 2010	31,161,319	1813 townships of 121 counties in six provinces of China	63.8 million	Roll-back re-emerging malaria in central provinces and reduce the burden of malaria in resource-poor areas of central and southern China
R6	2007– 2012	11,865,704	12 border counties in Yunnan provinces of China and four special regions of Myanmar	3.5 million	Reduce the malaria burden of mobile Chinese workers crossing the common border in 12 project counties of five prefectures in Yunnan and reduce the malaria burden of local residents in four special administrative regions of Myanmar bordering with Yunnan
NSA	2010–2012	63,436,279	762 counties in 20 provinces of China	500 million	Reduce to zero of locally contracted malaria cases in China (except in some border areas in Yunnan province) until 2015
R10	2012–2013	5,080,078	Seven counties in Yunnan provinces of China and five special regions of Myanmar	2.2 million	Reduce the malaria burden in five special regions in Myanmar; monitoring drug resistance against artemisinin and its derivatives, control the number of imported infections and promote elimination of malaria in China

NSA, National Strategy Application.

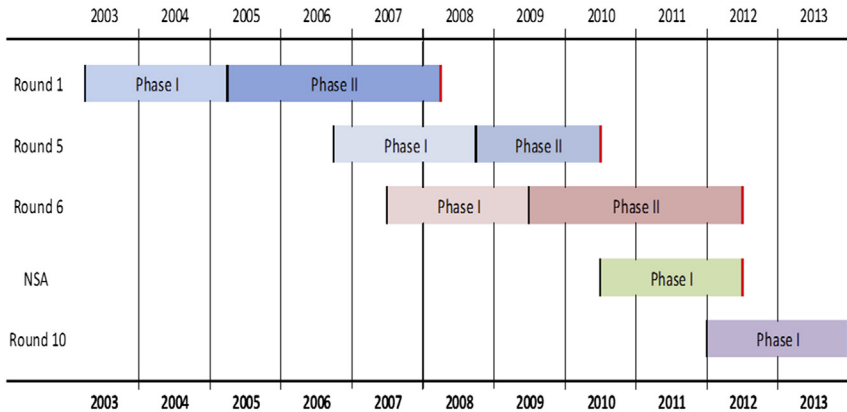


Figure 11.1 Sequence of implementation of GFATM malaria programmes in China.

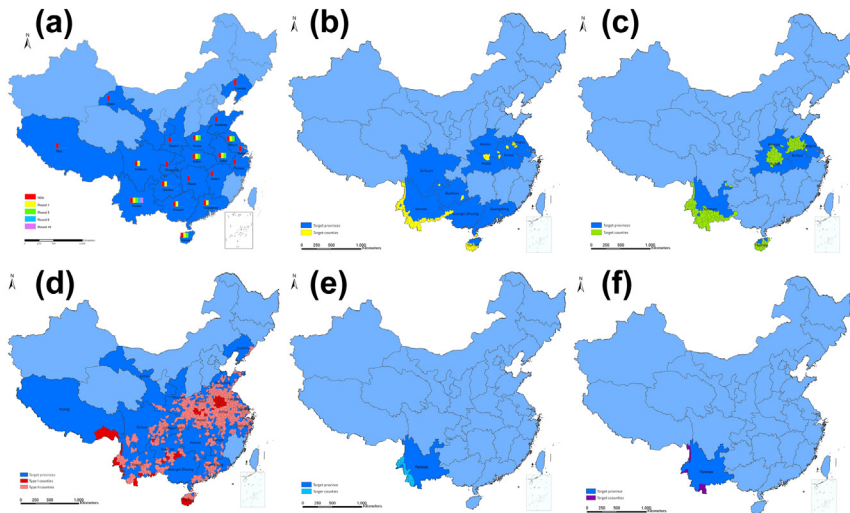


Figure 11.2 Target area of GFATM malaria programmes in China. (a) target provinces of R1, R5, R6, National Strategy Application and R10; (b) 47 target counties in 10 provinces of R1; (c) 121 target counties in six provinces of R5; (d) 762 target counties in 20 provinces of NSA; (e) 12 target counties in Yunnan province of R6 and (f) 7 target counties in Yunnan province of R10.

3.3 GFATM malaria programme in China: R6

GFATM malaria programme R6 covered 12 counties in Yunnan province of China and four special administrative regions in Myanmar on the China–Myanmar border. The programme activities in Yunnan province

were consolidated into the NSA in 2010 whereas the activities of Myanmar ended in 2012. The main content of R6 was (1) to improve the malaria control service for frequently mobile Chinese workers (FMCWs) in Yunnan; (2) to improve the malaria service accessibility and quality for FMCW and local residents in Myanmar and (3) to develop cross-border malaria surveillance, information exchange and joint prevention mechanisms.

3.4 GFATM malaria programme in China: NSA

According to the original proposal, the NSA was intended to last 5 years. However, the programme ended ahead of schedule on June 30, 2012, after the relevant decision of the 25th GFATM board meeting. The programme covered Type 1 and Type 2 counties and its objectives were (1) to offer timely diagnosis and proper treatment to malaria patients, (2) to improve malaria prevention, (3) to enhance malaria control of populations at high risk and (4) to further improve the malaria surveillance system.

With the principle of the one strategy plan and resource consolidation, NSA consolidated two programme grants (R5 and R6) and consolidated all of the resources on malaria elimination in China. NSA was in line with the NMEP, including the goal, objectives, indicators and main activities. The target area of NSA spread to the lower malaria-burden provinces, and the previous grants only covered the high malaria-burden provinces.

3.5 GFATM malaria programme in China: R10

GFATM malaria programme R10 covered five special regions in Myanmar on the China–Myanmar border and seven border counties in Yunnan. The target population included 586,000 local residents and 100,000 Chinese migrant workers in Myanmar as well as 1.5 million frequent border crossers. The main activities were (1) to improve access to diagnostic and treatment services; (2) to improve access to LLINs; (3) to maximise the utilization of preventive, diagnostic and treatment services through the production of information education communication (IEC)/behavioural change communication (BCC), and (4) to strengthen project implementation, management and information exchange and enhance the efficiency of cross-border malaria control.



4. PROGRAMME MANAGEMENT

In 2003, programme management was a new concept for malaria control in China. Under the leadership and supervision of the Ministry of

Health (MOH), local health bureaus of provincial governments and county governments, the GFATM malaria programme established a management system on basis of the CDC infrastructure. A series of documents, including programme agreements, work plans, and the *Handbook of Management and Technology* were issued upon launch of each programme. Monitoring and evaluation (M&E) activities, procurement activities and financial and audit activities ensured that all programmes were progressing smoothly.

4.1 Management structure

As the Principal Recipient (PR) of GFATM programmes in China, the China CDC was responsible for implementing and managing the GFATM programmes under the guidance and supervision of the Country Coordinating Mechanism for the GFATM Programmes (China CCM). The PR established nine office or departments, including Programme Office, Financial Department, Procurement Department, M&E Department, Human Resources Department, Audit Department, NPO for AIDS, NPO for Tuberculosis, NPO for Malaria. The three NPOs were responsible for planning and implementing specific Programmes.

The NPO for Malaria of R1, R5, R6 and NSA was facilitated by the National Institute of Parasitic Diseases (NIPD), China CDC in Shanghai to execute all of its functions whereas the R10 grant was implemented in conjunction with the Yunnan Provincial Bureau of Health. The NPO for Malaria, in cooperation with the PR, was responsible for the development and implementation of plans, disbursement requests, financial management, procurement and assets management supervision, assessment, technical assistance (TA), programme balance statements and reports, consolidation and submission as well as receiving supervision, instruction and audit initiated by relevant government authorities (Tang, 2009).

Sub-recipients (SRs) were based in local CDCs, which were responsible for conducting programme-related activities (e.g. trainings, M&E, finance management etc.) Local health bureaus of provincial governments and county governments were responsible for supervising the implementation of the programmes. Township hospitals mainly performed malaria diagnosis, treatment and health education (Figure 11.3).

4.2 Programme implementation mechanism

The programme implementation was performed in accordance with the agreement signing covering agreed work plan and M&E plan between GFATM, and PR. After an agreement had been signed with the GFATM, the

PR signed the programme agreements with the health bureaus/or CDCs of the target provinces and partners. Target provinces then signed programme agreements with the health bureaus/or CDCs of target counties.

The work plan, M&E plan and procurement and supply management plan approved by the GFATM and MOH were annexed to programme agreements. Considering the local malaria epidemiology, specific work plans were developed at lower levels to perform the project activities. Standard documents such as the *Financial Management Manual*, the *Procurement and Asset Programme Manual*, the *Audit Guideline*, and the *Programme Management and Technical Guidelines*, issued by PR, were used to guide project execution and project control.

4.3 Monitoring and evaluation

M&E allows measurement of the progress and effectiveness of a programme at all levels. All GFATM programmes in China developed an M&E plan and a performance framework to capture data on the impact of the interventions, monitor their effectiveness and ensure financial and programmatic accountability.

The M&E plan defined indicators, data management, programme supervision, etc. In 2003, the M&E plan was only used for the GFATM programme

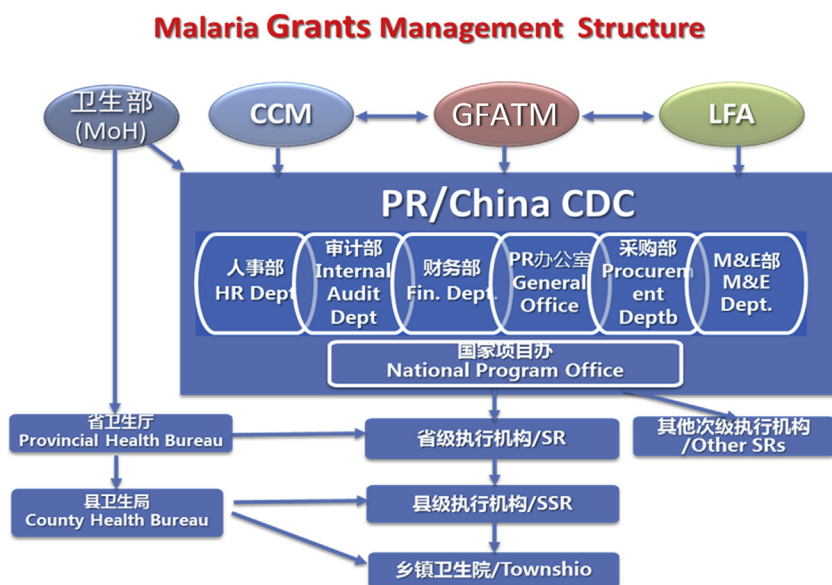


Figure 11.3 Global Fund malaria grant management structure in china. (CCM, Country Coordinating Mechanism for the GFATM Programmes; GFATM, Global Fund to Fight AIDS, Tuberculosis and Malaria; LFA, Local Fund Agents; PR, Principal Recipient).

in China. In 2010, the M&E plan and framework were enhanced to support both the NMEP and the NSA.

The numerator and denominator of indicators, collection methods, frequency and coverage of data were definitely prescribed in the M&E plan. For the malarial programme, the indicators were classified as impact indicators, outcome indicators and progress indicators. Totally, there were 14, 15, 19 and 22 indicators in R1, R5, R6, NSA, respectively. The proportion of impact and outcome indicators per round increased over rounds (Zhao et al., 2011).

The baseline surveys to establish indicators were completed at the beginning of each programme, and the results were semi-annually measured and reported through the programme process reporting system. All data were verified at all levels.

The PR and NPO conducted supervision of each province each year, the Provincial Programme Office conducted supervision of counties twice per year, the Prefectural Programme Office conducted supervision of townships twice per year and township hospitals conducted supervision of villages 1–2 times per year. The problems found during supervision were followed up to be rectified. Meanwhile, R5 received a data quality audit (DQA) mandated by the GFATM in 2008. The result of the DQA indicated that the data generated by the malaria programme were of high quality.

To evaluate the effects of the programme in more detail, R1, R6 and NSA mandated experts of universities and research institutes to externally evaluate the programme implementation. The evaluation mainly focused on the completion of work plans, the results of M&E indicators, programme implementation capabilities, investment in malaria control and prevention and the degree of satisfaction of people who were to benefit from the programme. Several suggestions and recommendations of these programme evaluations were used for the national malaria control and elimination programme. The NSA also received a diagnostic review, conducted by the GFATM in 2011, which found no major problems.

4.4 Procurement and supply management

All health products, equipment and material used or distributed in the frame of the GFATM-supported projects were procured through public bidding. The procurement procedure was open, transparent and equitable in accordance with relevant laws of China. New malaria control products such as LLINs, RDTs and ACTs were successfully introduced to China. In accordance with GFATM policy, only LLINs approved by WHO's Pesticides Evaluation Scheme (WHOPES) (WHO, 2007) were procured, the RDTs were recommended by WHO and anti-malarials were pre-qualified by WHO. In 2006,

only one sort of 'WHOPEs-approved' LLINs was registered by the Ministry of Agriculture in China, and no RDTs were registered by the China Food and Drug Administration (CFDA). Thus, RDTs were initially only procured through the reimbursable procurement of WHO. However, in 2012, three 'WHOPEs-approved' LLINs and one RDT had been registered in China, and many anti-malarial manufacturers had applied for pre-qualification.

An Inventory Management System was set up in programme areas, and an inventory officer was responsible for inventory information management at each level. The inventory information was collected and analysed to avoid stock-outs and waste. All CDCs at each level had set up warehouses, and products were quickly distributed to township hospitals through the CDCs system. Every distribution was recorded in detail, with signature. The allocation of products was adjusted according to the progress of programme activities, and buffer-stocks of products were to be kept.

4.5 Financial management and audit

The performance-based funding mechanism was introduced since the beginning of the programme in China in 2003. The NPO semi-annually submitted a disbursement request for programme funds to the GFATM on the basis of the semi-annual performance reports of the SRs. Programme funds were then disbursed to SRs within 10 working days after receipt from the GFATM. A *Financial Management Manual* was issued, financial management training was held once every year and financial supervision was performed once every year. The semi-annual financial reports were submitted to the GFATM through the 'China Global Fund Financial Management System'.

To ensure that expenditures were real, legitimate and reasonable, external and internal audits at each level were performed once a year. External and internal audits reviewed the internal financial control system, budget fund allocation, budget implementation, completion of the main indicators, accounting of current accounts, monetary funds, inventories, fixed assets accounting and so on. Any rectifications were performed in a timely manner according to the findings contained in the audit report.



5. PROGRAMME INPUT

5.1 Fund

As of November 2012, the GFATM had disbursed a total of USD 116 million to support the Chinese malaria control and elimination programmes. These funds played an important role in helping China to achieve its malaria

control goals. The peak of disbursements was reached in 2010 because the funding of NSA in 2010 was more than the other grant (Figure 11.4).

5.2 Health products, equipment and materials

From 2003 to 2012, the GFATM-supported malaria programs procured and distributed 5516 microscopes, 6655 sprayers, 967,560 RDTs, 2,399,069 person-doses of drugs, 1,823,153 LLINs and 178,074 L of pesticide. In addition, vehicles and office equipment improved the hardware of CDCs and facilitated programme activities and malaria control (Table 11.2).

Data from the GFATM database including 1514 entries from 79 countries show that the costs for LLINs and RDTs dropped significantly from 2005 to 2012 (Wafula et al., 2013). In China, the cost for purchasing a single LLIN decreased from 38 RMB in 2006 to 28 RMB in 2012 and that of RDTs maintained at approximately 0.7 USD.

5.3 Human resources

CDC staff were responsible for most of the programme activities such as diagnosis, treatment, vector control, surveillance, data collection, data analysis and management. The salaries of CDC staff were provided by governments at each level, but township hospital and village doctors were provided with incentives to improve case management and reporting. Because of

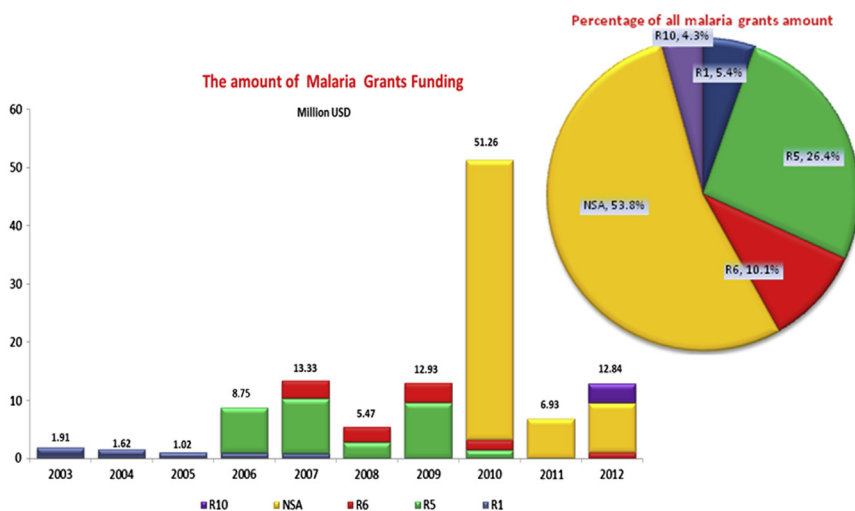


Figure 11.4 Annual amount and percentage by each round of GFATM malaria programme from 2003 to 2012 in China.

human resources limitations, some partners recruited new staff to perform malaria programme activities.

For programme staff, annual training in M&E, financial management, procurement and supply was held at each level. The management capacity at each level was enhanced to ensure that the programme was correctly implemented. (Re-) training courses on diagnosis, treatment, vector control, surveillance etc. were provided to a total of 444,941 trainees with support of the NSA. All township microscopists and 98% of the village doctors in programme areas were (re-)trained. A sample survey of 27,499 township and village doctors in 2012 showed that 94.9% of them were satisfied with the training of the programme.













With support of R5, approximately 15 persons gained their Master's degree in public health management and technical specialties, some of which were related to the technology or management of malaria control in China.



6. MAIN PROGRAMME ACTIVITIES AND OUTPUT

Over the 10 years the GFATM malaria programme was implemented, approximately 1.40 million malaria cases (including suspected cases) were treated, 1.10 million patients infected in the prior year were treated, 2.80 million bed-nets were treated with insecticide and 1.80 million LLINs were distributed. Various local IEC/BCC materials were developed and distributed, and health education activities were performed, which improved the residents' awareness of malaria prevention and treatment.

Table 11.2 Number of health products and equipment procured for the malaria control programme in China by the GFATM from 2003 to 2012

Health product and equipment	Equipment
 Medicine: 2,399,069 (person-doses)	 Cars: 538 (units)
 Insecticide: 178,074 (litres)	 Motorbikes: 1908 (units)
 RDTs: 967,560 (units)	 Computers: 1461 (units)
 LLINs: 1,823,153 (nets)	 Cameras: 1012 (units)
 Microscopes: 5516 (units)	 Projectors: 802 (units)
 Sprayers: 6655 (units)	 Small refrigerators: 1600 (units)

RDTs, rapid diagnosis tests; LLINs, long-lasting insecticide-treated nets.

6.1 Case management

For diagnosis, microscopy remained the gold standard method throughout the programme. The diagnostic options increased from only one method (microscopy) at the time of the R1 to three methods including microscopy, RDTs and polymerase chain reaction (PCR), in the NSA period. In 2005–2010, 81 countries used RDTs for malaria diagnosis in project supported by the GFATM, improving the case management of acute febrile illness of children (Zhao et al., 2012). RDTs were the primary diagnostic tool in the remote villages in southern China in 2008–2012. Microscopy and RDTs have lower sensitivities than PCR (Yan et al., 2013). PCR was mainly used for case verification in provincial CDC and NIPD because of the lack of PCR equipment in county CDCs and townships.

The quality assurance (QA) system was updated by establishing a network of reference laboratories, setting up microscopy oversight teams and (re-)training microscopists. Microscopes and related materials were provided to township hospitals and periodic double-checking of malaria diagnosis was provided.

A total of 13 provincial reference laboratories were established, and all 762 counties in 20 provinces and autonomous regions set up microscopy monitoring groups for quality control. RDTs were adopted to detect malaria in Yunnan, Hainan, Guizhou and Xizang provinces or autonomous regions. A total of 12,485,598 fever patients received microscopic tests in the frame of R1, R6 and NSA (Table 11.3).

Before 2010, case detection mainly relied on blood examination for fever patients in hospitals at all levels. Since the implementation of NSA, in addition to blood examination, active case detection (ACD) was performed to find infection sources.

Treatment competence was strengthened through special training and the provision of appropriate anti-malarial drugs. In China, patients with *P. vivax* received chloroquine/primaquine (CQ/PQ) treatment and patients with *P. falciparum* received artemisinin therapy before the implementation of R5. In 2006, ACT for *P. falciparum* and copackaged CQ/PQ for *P. vivax* treatment were first used in the programme areas of R5. Then, the national malaria treatment policy was revised to use ACT as the first-line therapy for *P. falciparum* case treatment in line with international policy. Artemisinin monotherapy for uncomplicated malaria was no longer to be used, and injectable artesunate was used to treat severe or complicated malaria. In addition, the treatment with primaquine for the radical cure of *P. vivax* cases ('spring treatment') was provided in R1, R5 and NSA during pre-transmission season in March or April.

The follow-up for case treatment was provided by village doctors. The CFDA performed routine anti-malarial drug quality testing and QA at all levels, from manufacturing over distribution to storage. A total of 1,504,613 confirmed and suspected malaria cases were treated between 2003 and 2012 (Table 11.4). Since 2004, each malaria case was reported on time through the national notifiable infectious diseases reporting system network.

6.2 Vector control

LLINs are a key malaria control strategy of relevant programmes worldwide (Ghebreyesus et al., 2008). In the highly endemic areas of Yunnan, Hainan and Guizhou provinces, LLINs were distributed and nets were treated with insecticide (ITNs). Meanwhile, in four special regions of Myanmar, the

Table 11.3 Malaria diagnosis in the GFATM malaria programmes in China

Round	Microscopic test (number of fever patients received)	RDTs	PCR
R1	Case detection and verification (2,530,245)	X	X
R5	Case detection and verification (not available)	<i>P. falciparum</i> diagnosis in remote villages of Yunnan and Hainan province	X
R6	Case detection in malaria diagnosis and treatment post (548,872)	Case detection by mobile medical team	X
NSA	Case detection and verification (9,406,481)	<ul style="list-style-type: none"> • Primary method of diagnosis limited to remote villages mainly in Type 1 counties • Backup in programme counties at the township level • Febrile patients among travelers screening at most international ports of entry (air, sea and land) 	Case verification
R10	Case detection and verification (not available)	Case detection by mobile medical team	X

RDTs, rapid diagnosis tests; PCR, polymerase chain reaction.

local residents and mobile population also received LLINs through R6. The distribution of LLINs and ITNs were free of charge, with exception for the LLINs distributed through social marketing in R5 in eight counties of Yunnan province.

LLINs were distributed based on the malaria incidence in the programme areas and the economic conditions of the households. All nets in the programme area were treated once per year immediately before malaria transmission season before 2010. Only nets of villages with an incidence <1% in the previous year were treated with insecticide after 2010, and LLINs were distributed in the villages with an incidence $\geq 1\%$; 1.8 million LLINs were distributed and 3.56 million ITNs were distributed (Figure 11.5).

Net ownership can be significantly improved in a short time, but net use is not always proportionally increased (Shargie et al., 2010). The percentage of households at risk receiving at least one LLIN/ITN in the last 12 months was 88.3% in China in 2012, and the fraction of the population at risk who reported sleeping under LLINs/ITNs at the previous night was 65.1%.

Indoor residual spraying (IRS) for vector control was only used in confirmed transmission foci. In 2012, 3941 foci received IRS, and the effectiveness was assessed to ensure that residents received better protection from the malaria infections.

Table 11.4 Malaria treatment in GFATM malaria programmes in China

Round	Number of cases (confirmed and suspected)	Treatment scheme	Spring treatment
R1	517,220	<ul style="list-style-type: none"> • CQ/PQ treatment for patients with <i>Plasmodium vivax</i> malaria • Artemisinin therapy for patients with <i>Plasmodium falciparum</i> malaria 	✓
R5	738,462	<ul style="list-style-type: none"> • Co-packaged CQ/PQ treatment for patients with <i>P. vivax</i> malaria • ACT for patients with <i>P. falciparum</i> malaria 	✓
R6	211,286	The same as R5	X
NSA	37,645	The same as R5	✓
R10	No reported	The same as R5	X
Total	1,504,613		

CQ/PQ, chloroquine/primaquine; ACT, artemisinin-based combination therapy; Spring treatment, or radical treatment of *Plasmodium vivax* malaria cases with combined use of chloroquine and primaquine to prevent the relapse of malaria.

6.3 Health education and community mobilization

All provinces and partners performed investigations on health education needs and developed locally appropriate IEC/BCC methodologies and materials in conjunction with the various target groups. For example, in Yunnan province, the materials printed consisted of local minority language calendars, notebooks, picture posters, videos and so on. These were each targeted for the different population needs of students, residents and cross-border mobile workers (Table 11.5).

BCC activities were performed by NGOs, the Ministry of Education (MOE) and CDCs by way of IEC material distribution, television, radio, short messaging service (SMS), websites, health education courses, community activities, face-to-face communication and so on. Approximately 400 million people received anti-malaria health education. Since 2005, the day of April 26th has been defined as a ‘Chinese Malaria Day’, immediately after the April 25th ‘World Malaria Day’. During ‘Chinese Malaria Day’, many IEC/BCC activities are held all over the country (Table 11.6).

6.4 Malaria control for populations at high risk

In contrast to highly endemic areas of Africa, where malaria mostly affects pregnant women and children, the population at highest risk in China

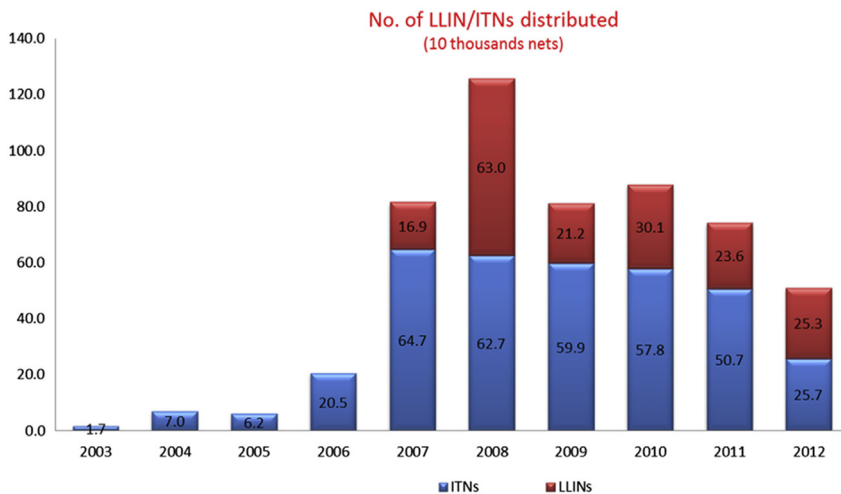


Figure 11.5 Number of long-lasting insecticide-treated nets/nets treated with insecticide (LLINs/ITNs) distributed by GFATM programmes from 2003 to 2012 in China.

was exposed to risk factors related to work activities and location of residence. For example, the forest-goers in Hainan province were the high risk population of malaria infections. Some ethnic minority people of Yunnan, Hainan and Guizhou provinces as well as international migrants are at high

Table 11.5 IEC/BCC activities in the frame of the GFATM malaria programmes in China

Round	IEC/BCC activities
R1	<ul style="list-style-type: none"> • 259,640 anti-malaria posters exhibited in public areas • 12,644 anti-malaria IEC courses held for primary and secondary school students • Malaria programmes over radio or TV broadcasted 532 times for target counties
R5	<ul style="list-style-type: none"> • Village doctor training CDs distributed by NPO • Various locally appropriate IEC/BCC materials targeting different populations distributed such as booklets, aprons, leaflets and fans; flyers on correct use of bed-nets, materials and calendars for international travelers • Participatory community health education activities (e.g. dramas and song contests) • Malaria counseling rooms, bulletin boards and multi-media screens in border ports • TV and radio health education advertisements as well as knowledge lectures • 10,758,415 primary and middle school students received education on malaria control
R6	<ul style="list-style-type: none"> • 276,617 families reached by face-to-face community activities • 133,455 primary/middle school students and 5025 villagers trained • 2079 village committees for malaria control established • 267,000 calendars and 7000 posters delivered
NSA	<ul style="list-style-type: none"> • 306.81 million pieces of IEC materials distribution or exhibited • Health education activities for students of 4663 primary and middle schools in seven provinces • Community health education activities in 13 counties of Yunnan and 12 counties of Guizhou • 176,879 families visited face-to-face by a health worker in 3115 natural villages of four counties of Yunnan • 100,000 people received consultation, 1.3 million IEC materials distributed at entry and exit ports
R10	<ul style="list-style-type: none"> • IEC/BCC materials distributed • IEC/BCC activities conducted at Chinese Malaria Day

IEC, information education communication; BCC, behavioural change communication; NPO, National Programme Office.

Table 11.6 Amount of IEC materials distributed in the frame of the NSA

Category	Name	Number (x 10,000)
Publicity materials	1. Poster (poster, brochure, flyer)	1320
	2. Calendar	32
	3. Microscopy map	4
	4. Promotional display panel	0.1
Household materials	5. Teacup (glass, disposable cup)	645
	6. Shopping bag, apron	139
	7. Anti-mosquito product (i.e. electric mosquito swatter)	1
	8. Clothing (T-shirt, cuff)	19
	9. Umbrella	10
	10. Facial tissue	327
	11. Travel bag	1
	12. Plastic fan	33
	13. Towel	4
	14. Poker	48
	15. Flashlight	4
School materials	16. Exercise notebook (stationery box, visual chart)	336
	17. CD-ROM	6
	18. Health education book	2
Office materials	19. Pens (pen holder, advertising pen)	125
	20. Mouse pad	1
	21. Office notebook	11
Total		3068.1

IEC, information education communication.

risk of malaria infections as well. Meanwhile, the higher malaria incidence across the south border of China affects the malaria transmission patterns in Yunnan province (Chen et al., 2010). The population at highest risk mainly included the mobile workers on the China–Myanmar border of Yunnan province.

The key activities for populations at high risk were to expand and strengthen coverage of integrated malaria services through distributing LLINs or ‘malaria packs contained with LLINs, piperaquine and IEC materials’ as well as providing IEC/BCC materials in cooperation with partners. Meanwhile, travelers back from Africa and other endemic countries received IEC/BCC materials, and RDT screening was conducted at all ports. On the China–Myanmar border, eight mobile medical teams and 73 malaria consultation posts were established in R6 to provide malaria

diagnosis and treatment services to the mobile workers crossing the border. Malaria control activities among mobile workers who involved in road construction or working on plantations and in forest areas were conducted in the six provinces where covered by GFATM malaria programme of R5.

6.5 Malaria surveillance

With the further improvement of national malaria surveillance system the epidemic response capability at the county level was strengthened through training and the provision of equipment, RDTs and insecticide for IRS. Surveillance technical skills trainings were held to improve the quality of case reporting (Zhou, et al., 2013).

An anti-malarial drug resistance surveillance network was set up in R5, R6 and NSA, including *in vivo* and *in vitro* monitoring of ACT efficacy and *in vivo* study of chloroquine efficacy. Anti-malarial drug quality testing in the private and public sector was conducted in Yunnan. Mosquito density surveillance and insecticide resistance surveillance activities were performed in 200 sentinel counties in the frame of the NSA. *In vitro* testing of sensitivity to anti-malarial drugs was performed on the China–Myanmar border with support of the GFATM because *P. falciparum* have high resistance to chloroquine in that area (Zhang et al., 2012), as well as artemisinin resistance for *P. falciparum* infection has been suspected in the areas on the China–Myanmar border (Huang et al., 2012).

Since 2010, every reported case was followed up, resulting in 226,254 ACD activities involving 1,933,444 people surveyed which contributed to the clearance of infection sources timely.

6.6 Multi-sector cooperation

Through the programme, multi-sector cooperation on malaria control and elimination was established and continued to be improved. Before 2003, no NGOs took part in malaria control, but with the launch GFATM malaria programmes in China, some NGOs such as Health Unlimited/Health Poverty Action (HU/HPA), Humana People to People (HPP), and Population Service International (PSI) conducted many malaria control activities as partners. At first, they only took part in temporary activities such as monitoring and providing TA in R1. Six partners conducted activities as SRs, such as health education and promotion, LLIN distribution, anti-malarial quality control and malaria screening to the mobile population at border ports in R5. In R6, 70% of the funding was used for activities performed by two NGOs. Especially in the Myanmar

border areas, malaria control was mainly performed by HU/HPA. For the NSA, these partners continued to implement malaria elimination activities. Since R1, WHO provided TA to the Chinese malaria control and elimination efforts and the China GFATM malaria programme. Meanwhile, especially in elimination areas, the private sector was engaged in malaria diagnosis, treatment and reporting, etc. (Table 11.7).

6.7 Operational research

The operational research of GFATM grants focused on the scientific problems of malaria control and elimination in China. NPO developed operational research bidding guidance. Through public bidding, operational research proposals were selected and contracted. From 2007 to 2012, more than 40 operational researches were supported by the GFATM malaria programme in China. On the basis of the reviewing comments of malaria experts from universities and research institutes in China, a total of 28 studies of the NSA were granted in the seven fields, namely genetic screening (seven studies), vector control (seven studies), malaria diagnosis (six studies), surveillance (three studies), imported malaria (three studies), treatment (one study) and economic evaluation (one study). Some research results have been used for fighting malaria and providing technical support to malaria control and elimination activities (e.g. the *P. vivax* sporozite-carrying mosquitoes detected through loop-mediate isothermal amplification).



7. ACHIEVEMENTS AND IMPACTS

In China, great achievements on malaria control has been gained, for example, the malaria incidence decreased from 4 per 10,000 to below 1 per 10,000 over the past 10 years. As the biggest international cooperation programme focusing on malaria in China, the GFATM malaria programmes was instrumental in this success, which has produced tremendous impacts in the following six fields.

7.1 From malaria control to elimination in China

The GFATM malaria programmes including R1, R5 and R6 contributed to reduction of malaria transmission in these years. With the support of R1, the malaria burden in Yunnan and Hainan, the two provinces most severely affected by the disease, significantly reduced. The number of reported malaria cases fell from 6357 to 1844 in Hainan and from 13,816 to 4027 in Yunnan in 2003–2008. As late as 2004–2005, the

Table 11.7 The multidisciplinary partners involved in the GFATM malaria programme in China

Round	HU(HPA)	HPP	PSI	RCSC	MOE	CFDA	CIQ	WHO
R1	M&E	X	X	M&E	X	x	x	TA
R5	Community health education	X	LLINs social marketing	LLINs distribution	Student health education	QA of anti-malarials	Malaria screening in ports	TA
R6	Malaria control in Myanmar	Face to face health education	X	X	X	x	x	TA
NSA	Community health education	Face to face health education	X	LLINs distribution	Student health education	QA of anti-malarials	Malaria screening in ports	TA
R10	Malaria control in Myanmar	X	X	X	X	x	Malaria screening in ports	TA

HU/HPA, Health Unlimited/Health Poverty Action; HPP, Humana People to People; PSI, Population Service International; RCSC, Red Cross Society of China; MOE, Ministry of Education; CFDA, China Food and Drug Administration; CIQ, China Entry-Exit Inspection and Quarantine; LLINs, long-lasting insecticide-treated nets; NSA, National Strategy Application; WHO, World Health Organization; QA, quality assurance; TA, technical assistance; M&E, monitoring and evaluation.

malaria incidence was increasing in central China; with the support of R5, the 26,873 cases reported in 2008 were concentrated in a few provinces, and *P. falciparum* was confined to Yunnan and Hainan provinces. While the NSA began to be implemented in 2010 when the Action Plan of the National Malaria Elimination (2010–2020) was issued, resulting in the number of malaria cases continue to decrease sharply from 7855 in 2010 to 2718 in 2012. Under the joint efforts of Global Fund and China government, malaria incidence (1/100,000) decreased from 3.91 in 2003 to 0.2 in 2012 (Figure 11.6).

Much lower transmission of malaria has been observed in 2011, the annual reported malaria incidence in 88% of the 75 Type 1 counties was less than 1 per 10,000, and 21.33% of Type 1 counties and 86.17% of the 687 Type 2 counties reported zero locally transmitted malaria cases.

Over the 10-year period, most notably in the frame of R1, R5 and NSA, *P. falciparum* malaria was eliminated in Hainan province. The incidence in target counties of Hainan was 0.4 per 10,000 in 2007, and in 2011 there were no locally transmitted *P. falciparum* malaria cases. A case in point is Wanning city, which previously had been a highly endemic area and where transmission has dropped to zero since 2010 (Lin et al., 2013). In Yunnan, the *P. falciparum* malaria incidence dropped significantly year by year and was close to 0.12 per 10,000 in 2011.



Figure 11.6 Reduction pattern of malaria incidence correlated to the rounds of GFATM malaria programmes in 2003 - 2012.

In central China, the re-emergence of malaria was rolled back with the support of R5. From 2000 to 2006, a steady increase in malaria cases resulting from the re-emergence of *P. vivax* malaria in Henan, Hubei, Jiangsu and especially Anhui province had been recorded. In 2009, the outbreak in Anhui province had largely been contained, and the incidence in only 10 counties more than 1 per 1000. In Henan province, the incidence of malaria has decreased from 0.375 per 1000 in 2006 to 0.047 per 1000 in 2010 (Liu et al., 2011). With the implementation of the GFATM grants in Suining county of Jiangsu province, the number of malaria cases decreased from 37 cases in 2006 to 1 case in 2012, and the incidence decreased from 0.28 per 10,000 to 0.01 per 10,000, with the decline rate of 96.43% (Tang, 2013).

In the China–Myanmar border area, R6 and R10 were implemented from 2007 to 2012. The malaria burden of FMCWs and local residents in four special regions of Myanmar was significantly reduced, for example, the prevalence of malaria decreased by 94% among local residents of Myanmar last 5 years based on the surveillance data of HPA.

7.2 Filling the resource gap for malaria control and elimination

The malaria control and elimination funds of the governments at different levels mainly covered human resources, logistics, overheads, special malaria control and elimination funding. The programme areas were mostly poor and rural, with support focused on weak links in malaria elimination such as diagnosis, treatment, monitoring and awareness for malaria prevention (Bi & Tong, 2014). The existing funding gap was approximately 20% of the total malaria control and elimination budget in China, and it was promptly filled by the GFATM. It is important to note that the GFATM successfully leveraged the government at each level to increase malaria control funds. For example, from 2003 to 2012, the central government invested approximately 193 million RMB in malaria control and elimination, increasing from 5 million RMB in 2003 to 46 million RMB in 2012.

The health products and materials distributed by the GFATM greatly eased the lack of resources for malaria control and elimination in China. Health products such as microscopes, insecticide and RDTs filled the gap in malaria diagnosis and treatment in township hospitals, and LLINs boosted prevention of transmission. The procurement and distribution of materials

such as vehicles and office equipment also provided necessary help for the programme implementation and malaria elimination.

7.3 Improved multi-sectorial cooperation and communication

The multi-sectorial cooperation and communication greatly benefited malaria control in China. Many government sectors and NGOs played important roles in malaria control. In the past, no NGOs had been engaged in malaria control in China. In addition to CDCs, NGOs (HU/HPA, HPP and PSI), other government sectors (MOE, Food and Drug Administration and China Entry-Exit Inspection and Quarantine) and the Red Cross were involved in malaria control and elimination. Coordination meetings between CDCs and these partners were held regularly, and departments of tourism and commerce were also invited to attend these meetings. The number of provinces with multi-sectorial cooperation increased from 6 to 20 nationwide over the programme period. Together, these partners received 10% of the total funds from the GFATM malaria programmes in China.

7.4 Contribution to policy and ability of the national malaria control and elimination

Malaria control and elimination policy in the fields of diagnosis, treatment and vector control were revised over the course of implementation of the GFATM malaria programmes. As new malaria control techniques such as RDTs, LLINs and ACT were introduced to China, these new techniques were integrated into the national malaria control policy and spread to the entire country.

In terms of technical trainings, all microscopists, 98.02% of the village doctors and 63.41% of the medical workers in township hospitals were (re-)trained. Nearly half of the microscopy staff working with grass-root organizations was trained for several times. Thus, the programme improved the comprehensive control and prevention abilities at all levels. The test scores related to blood slide preparation and reading were significantly higher in GFATM-supported provinces than those not covered by the programme (Fu et al., 2012).

The programme staff benefited from its exposure to the management concepts of the GFATM and improved its ability to manage programmes better, such as handling of M&E, procurement, financing and audit (Li et al., 2009).

7.5 Enforced public awareness of malaria control and prevention

Health education materials targeting different groups were developed, and various health education and improvement activities were performed to

improve the awareness of malaria control and prevention in the targeted areas. For example, more than 60% of the students were aware of malaria among 44,519 students surveyed in 94 counties of 20 provinces in 2010 (Yin et al., 2013). After implementation of a GFATM grant in the four counties of Chongqing City, the malaria awareness rate of primary school students increased from 58.94% to 89.96%, that of middle school students from 52.83% to 86.06% and that of local residents from 56.74% to 83.89% (Wu et al., 2013). With constantly improving awareness of malaria control and prevention, the residents could go to the hospital immediately upon getting infected and actively took part in malaria control and prevention activities.

7.6 Cross-border cooperation mechanism for malaria control

A cross-border cooperation mechanism with NGOs was established through R6 and R10. On the basis of the platform of R6, information about malaria epidemic was exchanged regularly between border counties of Yunnan in China and the special regions of Myanmar. TA in the fields of malaria diagnosis and treatment was provided to the special regions of Myanmar in the form of human resources, training and M&E. A malaria control network was established and maintained in the four special regions in Myanmar with the help of R6 and R10. Sixty-eight malaria control consultation and service posts in Yunnan province and 73 health posts in Myanmar were established on the border. These health posts were equipped with microscopes and anti-malaria drugs. Seventy percent of the funds were used by the NGOs for malaria diagnosis and treatment and health education in Myanmar. Meanwhile, there was strengthened mobilization and coordination between local health bureaus of special regions in Myanmar and those of the border counties in Yunnan province, which improved the management and technical capacity of the officers from both countries.



8. LOOKING FORWARD

From 2014 onward, the GFATM will no longer support malaria control or elimination activities in China. However, it remains challenges, especially in rural areas of the country, such as the lack of funding for vector control, diagnostic testing and treatment. It has been argued that in addition to GFATM investments, international and domestic funds should be provided if malaria elimination targets are to be reached (Katz et al., 2011). The scale-up in funding should be sustainable, and governments should invest resources to support

robust, systematic and regular malaria control activities (Nahlen and Low-Beer, 2007). The central and local governments of China took timely measures to increase funding to fill the financing gap created by the termination of the GFATM in China.

At present, the incidence of malaria is at a very low level in most areas except on the China–Myanmar border of Yunnan province. In this area, malaria control and elimination remains a challenge, not least because of the difficulty of controlling a disease in the mobile population. Therefore, cross-border cooperation mechanisms among governments of China and Myanmar, together with the NGOs, need to be enhanced, and more funds should be invested for malaria control in this area (Tambo et al., 2014).

China has acquired solid malaria control and elimination experience in the fields of diagnosis, treatment, vector control, surveillance and capacity building (Liu, 2014). In addition to its domestic work, China is able to provide train facilities, including control experience and expertise, for Africa and the Greater Mekong sub-region on malaria control and elimination. In addition, Chinese malaria experts are able to take the responsibility in implementing malaria control and elimination in Africa under multi-lateral or bi-lateral cooperation mechanisms. Meanwhile, institutions in China need to further strengthen their cooperation with international agencies and foundations.



9. CONCLUSIONS

The GFATM malaria programme in China was the biggest international cooperation project in malaria control in the country. Over a decade, the GFATM programme effectively promoted the implementation of the NMCP (2006–2015) and the NMEP (2010–2020) (Zheng, et al., 2013). By the end of 2012, the number of reported malaria cases had dropped below 3,000 annually, a record that is the lowest number in the Chinese history.

On the basis of epidemiological data, project activities and performance indicators, the impacts of the GFATM project have been summarised in six fields. The experiences in different fields, including introduction of technology and management, best practice at community level, innovation in implementation, introduction of international standards and evaluation of the performance of multi-stakeholder cooperation mechanisms, were reviewed.

All rounds of the GFATM malaria programme, including R1, R5, R6 and NSA, had already ended successfully before 2013. After R10 closed in 2014, the GFATM completely stopped providing financial support for China

malaria elimination. The efforts in the post-GFATM era were proposed, such as achievements made over the past decade have to be maintained, and the NMEP (2010–2020) should be implemented as planned. It was recommended that the country is looking forward to continuing to cooperate with the GFATM on malaria control and elimination in both African countries and border countries, such as Myanmar.

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